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The Study of Weather and Crops.

BY SIR DANIEL HALL, K.C.B., LL.D., F.R.S.

MR. HOOKER'S papers open up a field of investigation which may become of cardinal importance to agriculture. We may define the method as the correlation of crop production with the previous meteorological data, the ultimate object as the prediction of the yields to be expected from a consideration of the weather conditions prevailing. Of course the question is beset with difficulties, and in consequence it must for some time to come remain entirely within the region of investigation and research.

The main difficulties arise from the imperfection of the data that are available for the purpose. In the first place, the yield of a crop represents the resultant of many factors, any one of which may have been the limiting factor at work. The foundations of a crop may be solidly laid, growth may proceed satisfactorily all through the critical season, yet the produce may be curtailed and all predictions falsified by the weather in the final stages. Sir Napier Shaw's prediction of the yield of wheat from the rainfall of the previous autumn holds good in five seasons out of six, in the sixth some other factor has had an overpowering influence. Studying the growth of the wheat plant we can distinguish three well-marked stages—the autumn and early winter during which the root system is being built up, the growing period, and, finally, the migration period, when the

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total material in the plant increases but little, but when the previously assimilated material is moved from roots, stem and leaves into the seed. During the first period a comparatively dry soil is essential, for the development of the root system is very dependent upon aeration; moreover, in a dry soil the roots are encouraged to extend in search of moisture. Given a deep and well-developed root-system the wheat plant becomes less dependent upon the immediate rainfall during the growing period, since it is drawing water from a thicker layer of soil at a greater depth, and therefore less exposed to evaporation. (This independence of the wheat plant to supplies of rain during the May-June period was well illustrated by the growth of wheat during 1921.) Growth and assimilation—the building-up of carbohydrates from the carbon dioxide of the atmosphere, are now the main functions of the plant, and the rate of action is, in the main, determined by temperature. By the time the flowering period is reached the wheat plant has to a large extent ceased to elaborate fresh material, the leaves are ageing and gradually begin to yellow off and die. After fertilisation the transfer begins of ready formed material in the plant to the seed, and the amount of grain produced depends upon this latter process. The "yield" in any season depends not only upon the growth, but upon the extent to which migration is accomplished. The latter factor may be approximately measured by the ratio of grain to straw, which, for example, varied from 60 : 100 in 1863 to 42 : 100 in 1852 on one of the completely manured plots at Rothamsted. In other words, 37 per cent. of the material grown became "grain" in 1863, whereas less than 30 per cent. became grain in 1852.

Of course there is also the possibility of a loss of crop by bad weather during the actual harvest; but, in practice, this is rarely a large factor, the quality may be injured, but the grain gets weighed.

Thus the final yield is determined by the cumulative effects of three, if not four, independent periods in the life-history of the plant, each probably requiring a different type of weather; nor will it be an easy matter to ascertain the relative part contributed by each to the final resultant. Again, this yield is never a simple resultant of various forces: there is always an element of compound interest about growth; if, for example, at an early stage the conditions are favourable to a good development of leaf, there is then more active material to take advantage of a further spell of good weather.

There are, again, imperfections in the meteorological data. In the main, only rainfall and temperature (mean or accumulated) have been considered. Even rainfall may be a deceptive figure,

what is really of moment is the supply of water to the roots, and this may be independent of the actual rainfall during the period under review. The effect of rain, again, cannot be a linear function, positive or negative; there must be an optimum condition and a falling off with excess in either direction. We have also to recognise the importance of humidity and illumination; in fact, we have, as yet, no means of defining, meteorologically, what every farmer recognises as growing weather.

Further investigation, then, is needed and, this may take place along two directions. We may have work on broad lines, similar to that of Mr. Hooker and Sir Napier Shaw, in which it is sought to establish correlations between the average crop yields of a country or similar area using the meteorological data usually available, or we may have intensive work which attempts to correlate the yield of a particular plot with a more searching examination of the weather it actually experiences. In the first case, the investigator is further handicapped by the fact that the crop yields, upon which he depends, are only estimates, and therefore subject to a large margin of error; in particular, the extremes, whether of high yield or low, tend to be underestimated.

Probably the second form of investigation is the more promising at the present time, because, until we can disengage the periods in the life-history of the plant, and assign some causal connection between the weather conditions prevailing and the progress of the crop at that period, we are without guidance in looking for the larger correlations. The problem would have to be simplified and reduced to its elements as much as possible. For example, a not unpromising field for investigation would be to examine the factors making for vegetative growth. The index might be the daily elongation of some plant like the hop with a single shoot, or the amount of grass or clover that resulted from a daily standardised cutting. Suitable arrangements could be made whereby the rainfall (or water supply in the soil), temperature and illumination factors could be made separately operative; of course, the factor depending upon the age of the experimental plant would also have to be distinguished. It would be an advance, even if daily observations of plant growth and weather data could be correlated so as to arrive at a definition of "growing weather."

But it would be idle to attempt to lay down the course of the investigation. Enough, perhaps, has been said to show that there exists a very promising field for research from either the meteorological or the plant physiological side; success is most probable if workers of each type will collaborate.

Aberdeen and Benson.

THE past month is remarkable for the announcement of two retirements: that of Professor Charles Niven, F.R.S., from the Professorship of Natural Philosophy at Aberdeen, to which was attached the care (on behalf of the Meteorological Office) of the Meteorological Observatory at King's College; and that of Mr. W. H. Dines, F.R.S., from the direction and management of the Aerological Observatory at Benson.

The Observatory at Aberdeen is the last example of the policy of the Meteorological Committee of 1867 to create meteorological observatories as subsidised adjuncts to institutions maintained by other bodies for scientific work. Kew, Glasgow, Stonyhurst, Armagh, Falmouth were all at one time on a similar footing. Professor Niven lent himself with great cordiality to any development of the work in his charge, Mr. G. A. Clarke was encouraged in his studies of clouds and the observatory was the earliest to follow Mr. Cave's lead in " pilot-ballooning " as a regular means of observation. Professor Niven, one of many distinguished brothers, was Senior Wrangler in his year at Cambridge and a prominent mathematical physicist for whom the New Physical Laboratory at Mareschal College was constituted and the observatory could always rely upon him for most efficient help.

Mr. W. H. Dines is also a link with the past. Devoted to the study of meteorology as a family tradition and endowed with all the qualifications that are implied by a training in mechanical engineering, a Wrangler's degree at Cambridge, long experience in teaching of mathematics, the habit of mind which sees what is there, no more and no less, and a personal knowledge of the ways of meteorology and meteorologists in society, he was exactly qualified to undertake the direction and management of an observatory for the upper air, and after some experience with kites at Oxshott, he took on charge the work on the Upper Air for the Meteorological Office in return for out-of-pocket expenses and a small honorarium, which was not large enough to interfere with his sense of freedom. He chose where he would live with a view to his observations; first at Pyrton Hill, where kites might be flown without undue anxiety, and next at Benson.

It was one of the first expansions of the work of the Office provided by the economies effected by the reorganisation of 1905. It has been successful beyond hope and expectation, though both were high. In the show cases at South Kensington are two glass models of the temperature distribution in the atmosphere for July 27th and 29th, 1908. They represent the high-water mark of the investigation of the upper air in this

country, unless the title be reserved for the launching of 25 balloons in 24 hours from Manchester on two occasions—June 2–3, 1909 and March 18–19, 1910, and to this day no other country can show the like of them.

The instruments, the methods of handling, the calibration, the reduction, are all due to Mr. Dines, and the instruments which he constructed have provided, in the competent hands of Mr. W. Patterson, an excellent account of the upper air of Canada. They have also made a beginning with the investigation of the upper air of Australia, perhaps at the moment the most necessary of all meteorological work.

Mr. Dines's summary in the *Characteristics of the Free Atmosphere** is remarkable evidence of personal achievement. Reference was constantly made to the facts and summaries given therein during the development of aircraft and engines. An appreciation of Mr. Dines's services to science and the State might very well be expressed otherwise, but he has at least the satisfaction of knowing that if the achievement of the maximum result with the minimum of cost is to be regarded as good service none is better than his.

Mr. Dines began with the study of wind, went on to the upper air, and at the end of his official service finds himself embroiled in radiation. With his unwillingness to accept what he cannot verify he is still busy with the distribution of temperature in the atmosphere. If he will recall what a crazy patchwork the science of Meteorology was acknowledged to be when he began his active share in it in the "seventies," and how much he has contributed to making it a tissue with a pattern in it he cannot fail to find encouragement to pursue this study of radiation in his retirement, with the assurance that the interest which those who look on take in his work increases and will increase with his increasing years.

NAPIER SHAW.

OFFICIAL NOTICE.

THE retirement of Mr. W. H. Dines, F.R.S., Assistant Director in charge of the Meteorological Office, Benson, Oxfordshire, is announced as from June 30th, 1922. The aerological work at Benson will be carried on by Mr. L. H. G. Dines. Mr. C. D. Stewart is appointed to Valencia Observatory in place of Mr. L. H. G. Dines.

* *Geophysical Memoirs, No.* 13. M.O. 220c, 1919.

The Royal Meteorological Society.

THE usual monthly meeting of this Society was held on Wednesday, June 21st, at 49 Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the chair

Messrs. J. E. Clark, H. B. Adames and I. D. Margary.—Report on the Phenological Observations in the British Isles for the year 1921.

Since the Royal Meteorological Society gave up the collection of meteorological observations its most important contribution to climatology has been the regular publication of phenological reports. These phenological reports deal with such matters as the time of appearance of flowers, the time of ripening of crops and of the migration of birds.

The year 1921, it will be remembered, was remarkable for the prolonged drought and persistent heat, and the report is therefore of special interest as dealing with the response on the part of plants and animals to the exceptional conditions. The early spring flowers bloomed 18 days before their average dates, but by July the flowering season was only early by six days. Grain cutting was very early. A poor fruit crop is attributed by the investigators to the mildness of the preceding winter and the premature blossoming. Among exceptional effects the following are noted: the frequency of second blossom after the August rains, the early departure of the swallows and the dearth of tortoiseshell and allied butterflies apparently from lack of nettles.

L. F. Richardson, A. Wagner and R. Dietzius.—An Observational Test of the Geostrophic Approximation in the Stratosphere.

The introduction by Sir Napier Shaw of the term " geostrophic wind " for the hypothetical wind which is supposed to blow along the isobars with such a speed that the tendency to a change of direction on account of the rotation of the earth is just balanced by the pressure gradient has done much to simplify the consideration of the complex problems presented by the dynamics of the atmosphere. It is important to remember, however, that in assuming that the actual wind is identical with the " geostrophic wind " we neglect centrifrugal force as well as the acceleration of the air in its direction of motion and the effects of eddy viscosity and of rising and falling currents. The " geostrophic approximation " is this assumption that the actual wind is the same as the geostrophic wind.

One of the reasons why this approximation is so good is that when only a small range of latitude is under consideration the

flow of air which is postulated is such that where the isobars are close together the speed is high, where the isobars are far apart the speed is low and there is no tendency for air to accumulate anywhere. If, however, the isobars under consideration extend through many degress of latitude the flow will be comparatively fast in low latitudes, comparatively slow in high latitudes, so that the air will accumulate in the north flowing currents at the expense of the south flowing currents. In his book on *Weather Forecasting by Numerical Process* Mr. Richardson arrived at a formula which expressed one of the results of this law of accumulation of the air in a mathematical form appropriate for certain specified conditions. With the co-operation of Dr. Wagner and Dr. Dietzius he has in the present paper investigated the agreement of the formula with the available observations.

Though the conclusion of this investigation can only be expressed in such terms as " there is probably something in it," the boldness with which the authors have utilised their material is most stimulating. Such work is the justification for the publication by international co-operation of the observations in the upper air.

A SUMMER meeting of the Royal Meteorological Society was held at Croydon Aerodrome on Wednesday, July 5th. The proceedings opened at 3 p.m. with a short address by the Meteorological Officer, Mr. G. R. Hay, who described the arrangements in practice at Croydon for supplying meteorological information to pilots. After the address the company were shown round the aerodrome and arrangements were made for short flights at 5s. a head. Tea was provided at the Trust House. The Society was unfortunate in having a very wet afternoon for its meeting, but in spite of the unfavourable weather a large number of the Fellows and their friends availed themselves of the opportunity afforded of " going up." The arrangements were made by Capt. S. Baker, the Civil Aviation Transport Officer in charge of the aerodrome.

Obituary.

The Prince of Monaco.—The death of Albert I, Prince of Monaco, brings to an end a career not only of a distinguished patron of natural science, but one of real eminence in the scientific world. Although not primarily engaged on meteorological work, his efforts being more especially devoted to biological oceanography, the Prince was keenly interested in climatological research. In 1892 he laid before the Academy

of Sciences, at Paris, a project for establishing high and low level meteorological observatories on a large scale, in different parts of the Atlantic Ocean. Stations on the Azores, Madeira, the Canaries, Bermuda and the Peak of Teneriffe were proposed, and it was suggested that Monaco should act as a centre for the collection and distribution of the information obtained. The Prince was an honorary member of the Commission for the Study of the Upper Air and of the Commission for Maritime Meteorology, as well as President of the Section for Physical Oceanography of the International Union for Geodesy and Geophysics. By his invitation the Commission for the Study of the Upper Air met on one occasion at Monaco. By the Prince's generous loan of the Yacht *Princesse Alice* Hergesell was enabled to carry out his valuable investigations of the air over the Oceans.

Adolphus Collenette.—The death of Mr. Adolphus Collenette, in his eighty-first year, following closely upon that of his veteran friend, Dr. Francis Carey, robs the island of Guernsey of another distinguished Meteorologist. Mr. Collenette, whose scientific interests were extremely diverse, spent the whole of his long life in his native island, where he was very widely known and respected. Trained originally to the medical profession, he early adopted the career of a chemist, but from 1880, when he collaborated with the late Dr. Hoskins in studying the climate of Guernsey, meteorology made ever increasing demands on his attention. After the death of Dr. Hoskins in 1888, Mr. Collenette greatly extended the scope of this work. He was appointed director of the States Meteorological Department and, as well as framing local weather forecasts, published an annual report containing rainfall records from all parts of the island and summaries of his own excellent observations. In the last year of his life he was engaged on the organisation of an official observatory designed in order that his work might be carried on after his death, a result which we have every reason to hope will be achieved.

Frederick William Sanderson.—Mr. F. W. Sanderson, Headmaster of Oundle, whose death, from heart failure, occurred suddenly at the conclusion of a lecture which he had been delivering at a Meeting of the National Union of Scientific Workers, was famous as an enthusiastic teacher and organizer. In 30 years he had developed Oundle from a small grammar school into one of the best equipped schools in the Kingdom. He established an efficient climatological station at the school, and observations have been contributed to Meteorological Office publications since 1903.

Correspondence.

To the Editors, "THE METEOROLOGICAL MAGAZINE."

Meteorology and Folk-Lore.—The Rainbow.

METEOROLOGICAL phenomena have always played a large part in human experience. Not least among these has been the arch of phantom colours which has spanned the heavens ever since rain fell and the sun shone.

The Hebrew, as recorded in the Book of Genesis, saw in the bow, which seemed to join heaven and earth, the token of God's covenant with Noah. To the Greek it was saffron-winged Iris, the messenger of Hera, "trailing against the sun her thousand shifting colours" as she darted earthward on some heavenly errand. To the Norseman it was Bifrost, guarded by the watchman Heimdall.

It is probably this latter connection with paganism which gave rise to the Yorkshire custom of "charming away" a rainbow with crossed fingers and a rhyme: and to the belief in Bohemia that not only is it unlucky to walk under a rainbow, but the rain falling through it blights the crops.

A pleasanter belief is the widely spread tradition (found in Sussex among other places) that there is a crock of gold buried at the rainbow's foot. The Bavarians add that to find this gold one must be a Sunday child, and that when found it amounts to three ducats.

The Canadian Indians say the rainbow is the dying breath of the "thunder-bird" slain by the sun, and in Longfellow's "Hiawatha" we find the beautiful idea of the "heaven of flowers."

> "All the wild-flowers of the forest,
> All the lilies of the prairie,
> When on earth they fade and perish,
> Blossom in that heaven above us."

Such are the ways in which man has striven to account for a beautiful optical phenomenon. To-day it has passed from the supernatural to the domain of the most unerring natural laws: yet such knowledge serves only to deepen our wonder, and makes us the more ready to echo the words of one of old:—

> "Look upon the rainbow and praise Him that made it, exceeding beautiful is the brightness thereof. It compasseth the heavens round about with a circle of glory, the hands of the Most High have stretched it." (Eccles. xliii.)

CICELY M. BOTLEY.

10, *Wellington Road, Hastings, May*, 1922.

Weather Lore.

I HAVE yet another "Simple Weather Forecast" to send you, which I find prevails both here in Wiltshire and in Berkshire.

On ploughing the fields in the winter the men come upon numerous burrows made by the longtailed field mouse . . . well stocked against the coming cold weather with grain, beans, etc. The position occupied by the opening of the burrows varies. When it points to the north, the men say we shall have a warm winter; if to the south a cold one is predicted.

Burns, however, who was so well acquainted with everything relating to farm work, says:

> "The best laid schemes o' mice an' men
> Gang aft agley."

I have no confirmation of the truth of the predictions; we can only wonder at and admire instinct without understanding it.

THEREZA STORY MASKELYNE.

Basset Down, Swindon, Wilts., June 20th, 1922.

Simple Weather Forecasting.

IN the June number of the Magazine, p. 132, Mr. Horner, referring to a "forecast" made by himself and Mr. Robertson in May of last year, adds: "If it was not 'forecasting the drought' which subsequently eventuated, I do not know what it was." Written, as this was, on April 4th of this year, Mr. Horner was in a position to know exactly what it was, but he has not ventured to disclose his thoughts. Perhaps the following will help readers of the Magazine to attach the appropriate value to it.

At the beginning of last March, Messrs. Horner and Roberston announced in the columns of a Sussex paper what they guessed would be the weather during the whole of the month. The middle of the month brought with it a good illustration of *qui s'excuse s'accuse*. "The dates given in our last forecast, published on March 2nd, have to be brought forward a few days owing to the fact that February being a short month was overlooked, and, therefore, the dates come later than were predicted."

With a persistency deserving of better luck they made yet another attempt to be even with their elusive prey, and on March 30th they made a plunge and asserted that "the present cold weather and unsettled conditions will probably continue until the end of the month, April, however, being ushered in with weather of a far more spring-like character." But from an early hour on the 1st of April Sussex was buried under snow, a gale of bitterly cold wind blowing, this snowstorm was followed by a month of the most wretched April weather since that of 1917. The "forecasts" have been discontinued.

To all who fancy that they, and they only, have discovered the innermost secrets of the future of atmospheric changes, and more particularly of those of the British Isles, it is recommended that they should carefully read and digest the articles on the subject in the *Athenæum* for 1837, p. 561, and 1838, p. 105—they are as true and appropriate to-day as they were in the days of our grandfathers, who were treated to "laborious trifling" by "the Tenterden Steeple" school of logicians.

H.

July 4th, 1922.

The Sun and the Weather.

Is it quite to the point for Dr. Chree to say that I had misunderstood Father Cortie's meaning seeing that he said "intense" and not "disturbed"? I think that it is only proper to assume that a scientific man means what he really says, and I much regret that we should have been at cross purposes.

My contention is that the number of electrons and protons shot out by the sun is probably greater during periods of sunspot activity than at other times. These, or some of them, when they reach the magnetic field of the earth, are directed towards the poles, and heat the upper atmosphere there. They may also be the cause, as many believe, of the aurora and of magnetic storms. If such be the case, a study of the aurora and of magnetic disturbances may yield results of meteorological value.

R. M. DEELEY.

Kew Gardens Road, Kew, June 15th, 1922.

Sunspots and Summer Rainfall.

I WAS very glad to see your *Sunspots and Summer Rainfall* note in the June Meteorological Magazine. Here July and August are totally different from June, which latter is practically as north-easterly as March, April and May, and more due easterly than any of those Spring months except May. From the solstice all is changed—just for two months; north-east wind duration is halved, east is much reduced and our rainfall is greatly increased. August ends this westerly spell and September is very similar to spring.

J. BAXENDELL.

The Fernley Observatory, Southport, June 20th, 1922.

Steaming Roads.

THE condensation of vapour in the air near the ground in the middle of a hot day is not very common. An instance which I observed at Bedford Park, Chiswick, on Sunday, June 25th, 1922, at 10h. G.M.T. should perhaps be placed on record. The morning had been bright and a few minutes before ten there was a very heavy squall. Going out immediately after the rain had stopped and the sun had come out I found mist sweeping over the ground in patches such as one sees over the river on a summer evening. In places the mist was breast high. It was being carried along by the wind at about three miles an hour.

The combination of circumstances seems to have been sufficiently heavy rain very nearly to saturate the air but not sufficient rain to cool the ground and prevent vigorous evaporation.

F. J. W. WHIPPLE.

Bedford Park, Chiswick, July 4th, 1922.

Drought in Herefordshire.

THE drought in this district throughout May and June, 1922, has been considerably worse even that last year. The combined rainfall of these months is only 1·44 ins. (May 0·66, and June ·78) compared with 2·66 ins. last year. The average for May and June is 4·58 ins., so that the actual fall has been only about one quarter. Last year the potatoes were saved by a heavy fall of 1·41 ins. on June 25th; this year we have had no daily fall exceeding ·26 ins. since April. Potato haulm is drying up, the strawberry crop has been practically a failure, and there is less hay and pasture even than last year. Matters would have been still worse had not the period January to April given us 15·31 ins. (4·06 ins. above the average); and though there is on July 1st still an excess of ·92 ins. on the year, this, after a deficit of over 15 in. in 1921, is more apparent than real. In March or early April *The Field* foretold drought conditions starting about mid-April and increasing in May and June, which would be broken by local thunderstorms in the east, but not so much in the west, where the dryness would be more pronounced. This has proved absolutely correct.

R. P. DANSEY.

Kentchurch Rectory, Hereford, July 1st, 1922.

Hailstorm in County Cork.

A SEVERE hailstorm was experienced in the Buttevant-Charleville district of County Cork on February 17th. In the parishes

of Churchtown and Ballyhea, situated in the track of the storm, the skylights in the creameries at these places were smashed to pieces. A considerable number of poultry were killed outright and cattle stampeded several miles. The storm, which was of about ten minutes duration, occurred during a lull in a westerly gale. The hailstones were described as being of the size and shape of an ounce plug of tobacco, the largest averaging half an ounce in weight. On melting they disclosed a quantity of black dust, like soot, but more grainy, with a markedly sulphurous smell. The storm traversed an area some 7 miles long, and about 1 mile wide, hail covering the ground to a depth of several inches.

SPENCER RUSSELL.

March 14th, 1922.

NOTES AND QUERIES.

Meteorology at the Royal Agricultural Show, Cambridge. July 4th–8th, 1922.

THE advent of wireless telegraphy has gone far to solve at least two long-standing difficulties of meteorological practice. That meteorology is a co-operative science is a truism. The preparation of a synoptic chart for the purpose of forming an intelligent anticipation of coming weather requires a vast and highly disciplined co-operative organisation. The necessity for collecting telegraphic reports from a large number of observing stations and the consequent costliness of every chart prepared, formed until recently an effective preventative from any attempt at forecasting by a private individual. The forecast room of the Meteorological Office was the only place in England where it was possible to prepare synoptic charts and make forecasts.

Radio telegraphy has profoundly changed all this. When once it had become possible to effect the ordinary international exchange of meteorological data by wireless, it had also become possible for any private individual to pick up the information, prepare his own chart and make his own forecast. Thus the first essential difficulty was swept away.

The other difficulty which has been solved by wireless telegraphy is that of placing the forecasts made by the official organisation before the public without delay. The possibilities of " broadcasting " forecasts have not yet been fully exploited, but it is perfectly obvious that radio-telegraphy provides a complete solution to this long-standing difficulty.

There has recently been a widespread awakening to the possibilities of the new means of communication. It has suddenly been realised that wireless telegraphy need not be confined to highly skilled electricians. Many thousands of amateurs are

now picking up messages—amongst them meteorological messages —and wondering what to do with them. A pamphlet* has just been published by the Meteorological Office for the purpose of answering this question, and the Royal Show has provided an excellent opportunity of giving a practical demonstration to that section of the community chiefly interested. The demonstration has been made all the more valuable by the fact that the wireless messages were received by amateur operators, using apparatus of a type within the means of most of the onlookers.

The suggestion that the Office should collaborate in such a demonstration came from Professor T. B. Wood, of the Cambridge University School of Agriculture. To Professor Wood also we have to acknowledge our indebtedness for very valuable assistance in the initial preparations. The wireless apparatus was installed and the reception of the messages was undertaken by Mr. D. R. W. Thompson, assisted by Mr. C. C. A. Hines, both of the University. The data for the British Isles, France, Norway, Sweden, Denmark, Holland, Belgium and Germany were successfully picked up and charts for 7h. and 13h. G.M.T. were prepared each day. Each chart was reproduced on a large blackboard, forecasts for the Cambridge district being written up alongside. The interest taken in the work was such as to justify fully the expectation that the preparation of weather charts will soon become a common adjunct to scientific farming.

The meteorological exhibit also included a complete climatological station, at which the usual routine observations were taken, as well as a large display of diagrams, apparatus and publications bearing directly or indirectly on the agricultural applications of meteorology. Many of the diagrams were prepared specially for the occasion. Among these may be mentioned a coloured representation of Mr. R. H. Hooker's climate and crop correlations for the east of England, and a diagram in which the harvest weather forecasts issued during 1921 were shown alongside a generalised representation of the weather day by day in the east and south-east districts.

E. G. B.

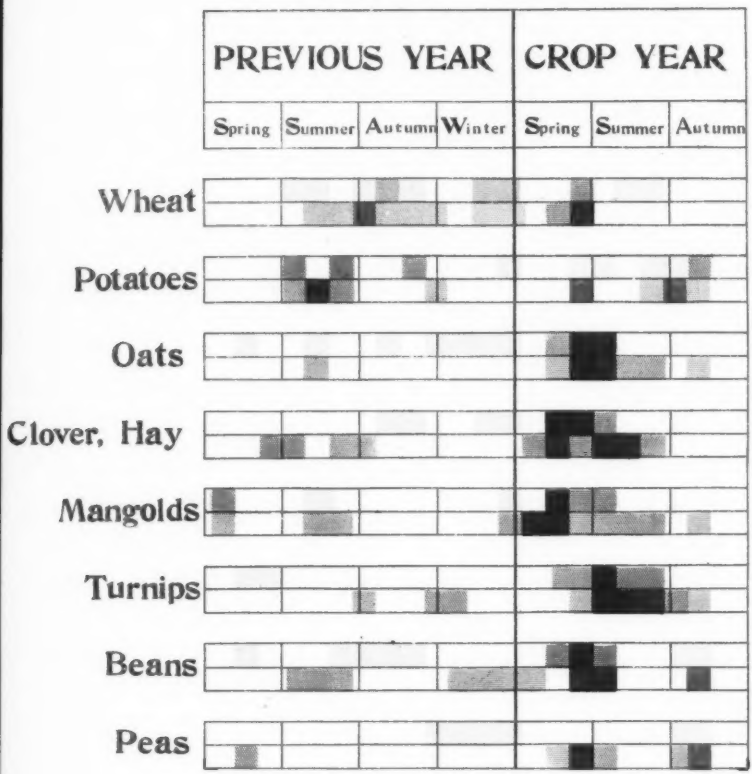
Weather Conditions favourable for Good Crops in Eastern England.

In the Meteorological Office Circular, August 1919, a coloured diagram was reproduced to illustrate the results of Mr. R. H. Hooker's study of the correlation of the weather and crops in

* *The Wireless Weather Manual.* M.O. Publication No. 255.

To face page 163.

WEATHER CONDITIONS FAVOURABLE FOR GOOD CROP YIELDS IN EASTERN ENGLAND.



Dry Wet Hot Cold

Indicates that comparatively high temperature for the time of the year is very favourable for the crops.

Indicates that comparatively high temperature for the time of the year is somewhat favourable for the crops.

Indicates that the effect of temperature in the crop is not marked.

Similar remarks apply to the other shades.

BASED ON R. H. HOOKER'S
"The weather and the crops in Eastern England"
1885–1921.

Eastern England.* In his presidential address to the Royal Meteorological Society last January,† Mr. Hooker placed his work on a surer foundation by utilising statistics covering 35 years, the earlier investigation having been based on the figures for 21 years only.

The accompanying illustration represents Mr. Hooker's new results.

In the paper the correlation coefficient for the size of the crop and the temperature of a period of eight weeks such as that from the 33rd to the 40th week is given. The periods of eight weeks overlap, however, and for our diagram each correlation coefficient has been regarded as characteristic of the central four weeks. For example, in the case of wheat, Hooker finds the correlation between the yield and the temperature of the period of eight weeks 33rd to 40th of the previous year is + ·40. We represent this by the deep red of the interval 35th to 38th weeks. Spring, *i.e.*, March, April, May commences with the 10th week of the year and so on. The colour scheme is shown under the diagram; "very favourable" is given when he correlation coefficient exceeds 0·40; "somewhat favourable" when the coefficient is between 0.20 and 0·40; "effect of temperature or rainfall not marked" when the coefficient is less than 0·20.

As to the significance of the diagram, readers are referred to Mr. Hooker's Address and to the discussion which is summarised in the last issue of the Meteorological Magazine. It is interesting to notice how general is the influence on the crops of the weather of the preceding year. This influence Mr. Hooker attributed to the requirements for good seed, but other authorities have laid stress on the effect of the weather on the condition of the ground at the time of sowing. At the end of a wet summer the ground is likely to be choked with weeds and require more careful tillage to secure satisfactory crops.

"May Dust."

(*Extract from the "Barbados Advocate," May 23rd*, 1922.)

"A PECULIAR phenomenon which has spread over the whole Carribbean from Barbados to St. Kitts and extending south almost to Demerara has been the prevalence of a low hanging mist which has shut off the horizon. For some time the idea prevailed that it was dust due to volcanic eruption, but this was removed by the reports from vessels arriving and from advices from the neighbouring islands.

"Captains trading in these waters for years state that they have never before experienced such continued low visibility at this time of the year. No scientific explanation of the phenomenon has yet been offered."

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* *J.R. Stat. Soc.* 70, 1907, p. 1.

† *Q.J.R. Met. Soc.*, Vol. XLVIII, No. 202, p. 115–138.

London to Paris Night Flights.

On May 31st a practical test of the lighting of the London-Paris air-way for night-flying on a commercial scale was carried out by General Brancker, Director of Civil Aviation, and Colonel Blandy, Controller of Communications, in a Handley Page service machine. The party, which also included Lieut. Biddlecombe, with a pilot, wireless operator and mechanic, left the London Terminal Aerodrome at Croydon at 22h. 20m. B.S.T., and, flying by compass and the guidance of aerial and coastal lighthouses, landed without difficulty at Le Bourget at 1h. 54m. B.S.T. on June 1st.

In order that the navigator before starting should have later weather observations than those usually available special 18h. and 20h. G.M.T. reports from stations in north-east France were obtained by previous arrangement by wireless from Le Bourget, and from the British stations on the route by telephone, and collected at the Meteorological Office at Croydon.

The weather was favourable, with little wind, though mist tended to obscure the ground at times.

The return journey was made in daylight.

On June 7th a night-flight from Le Bourget to Croydon was made by French personnel in a Farman-Goliath commercial machine. In this instance reports from south-east England were requested about an hour beforehand by the French Meteorological Office and as arrangements had been made in anticipation of such a request reports from 20h. to 24h. G.M.T. from Croydon, Biggin Hill and Lympne were available at the wireless stations on the route. Some of these were communicated by radio-telephony to the machine in flight.

The aeroplane left Paris at 22h 17m. B.S.T. and reached Croydon at 1h. 11m. on June 8th, the return flight being commenced after a short interval at 2h. 39m. and finished at 6h. 6m.

The weather on the British side was fine, with good visibility, but over north-east France a thunderstorm and, later, rain-squalls were encountered.

Curious Temperature Effect.

An interesting example of an inversion of temperature is reported from Benson Observatory, Wallingford. The frost on May 13th caught a walnut tree just as the leaves were beginning to come out. The tree was about 40 feet high: the foliage on the lower part was destroyed by the frost, while the top of the tree was not affected. The minimum temperature recorded in the screen for that date was 25°F.

The Mount Everest Expedition.

NEWS received by the Mount Everest Committee during June shows that much has been achieved by this Expedition, even though the prospects of full success this year have been reduced to a minimum by the early breaking of the monsoon on June 3rd. All altitude records had been broken on May 21st by Mr. Mallory, Major Norton, and Mr. Somervell, who, without using oxygen, reached 26,800 feet, and with hardly more physical discomfort than at the base camp at 25,000 feet, though the two first named were more or less frost-bitten. On a second attempt Mr. Finch and Captain Geoffrey Bruce, using oxygen, reached the still greater height of 27,200 (subsequently given as 27,300) feet, or only some 1,700 feet below the summit. Captain Finch's detailed account shows clearly the great difficulties entailed by the rough weather prevalent at the higher levels, the climbers having spent the night before the final push at 25,500 feet, to the accompaniment of a veritable gale of wind with heavy snow and very low temperature. Thanks to Captain Finch's ingenuity in repairing defects in the oxygen apparatus, the benefits derived from its use were most marked, even a moderate supply greatly encouraging both sleep and appetite. The final effort was to have been made on June 6th, but was frustrated by the monsoon, as already stated, and several members of the expedition, some suffering from frost-bite, have since returned to Darjeeling. In the absence of further official news it is impossible to judge whether the undertaking is being definitely abandoned for the present year, or whether a further attempt will be made, possibly in September. The general conclusion seems to be that rough weather is one of the greatest obstacles to success, and that the physiological effects of altitude may be more easily overcome than had been anticipated.

Weather Reports from America.

By agreement between the United States Weather Bureau and the French National Meteorological Service, coded weather reports are received in France from America by wireless telegraphy. These reports are broadcasted as an addition to a collective message, issued daily from the Eiffel Tower at 11h. 30m. G.M.T., which gives a synopsis of weather conditions over Europe by means of observations from selected stations. The American observations embrace barometric pressure, wind direction and wind force at about 30 stations forming a network over the whole of the United States and including in addition, Bermuda and several stations in Canada. They are made at 1h. G.M.T. of the

day of issue, and when combined with European observations and observations received by wireless telegraphy from ships in the Atlantic, enable the Meteorological Office, Air Ministry, to obtain a representation of the meteorological situation, within 12 hours of the time of observation, over a large section of the Northern Hemisphere extending from the Pacific seaboard of America in the west to Russia and Egypt in the East.

This marks an important addition to the services which wireless telegraphy is rendering to meteorological science.

Simple Weather Forecasting.

In the April number of this Magazine a note was published under the heading "A Test of Simple Weather Forecasting" in which the dictum "When the cold snap in the spring occurs early, the summer will be early" was discussed. Reference to the book *Simple Weather Forecasting for Everyone* shows that the correct quotation (p. 35) is "If this 'May Weather' comes early we can generally expect an early summer, but if late the summer will usually be belated also," which should be read in conjunction with the statement (p. 13) "Although the tendency is for this period" (*i.e.*, the May cold weather period) "to occur about the 12th of May, it may happen as early as the middle of April or as late as mid-June."

The investigation with regard to cold snaps in February and March was entirely beside the point and the criticism based on it must be withdrawn. We offer our apologies to Messrs. Horner and Robertson, the authors of *Simple Weather Forecasting for Everyone.*

Reviews.

Niederschlags-Schwankungen in Norwegen. Erste Mitteilung. By B. J. Birkeland. Geofysiske Publ., Vol. I., No. 3. Kristiania, 1920. Size 12 by 9, pp. 62, 2 plates.

This volume deals in great detail with the rainfall of twenty stations in Norway covering the forty years 1876 to 1915. The actual monthly and annual figures are dealt with very briefly, only the normals being given in Table I., but the bulk of the work is concerned with the individual monthly totals treated as percentages of the forty-year annual mean for each station. These figures are discussed, without regard to their absolute values, as deviations from the corresponding monthly normals. To take an example, at Skudenes the normal January rainfall is 9·1 per cent. of the normal annual fall (40 years), while in

January, 1915, the total was only 7·8 per cent. of the normal annual fall for the forty years; the deviation from normal is accordingly −1·3 "per cent. of annual normal." It is claimed for this method that in calculating the deviation of rainfall over the whole country by its use, the records at the drier stations are not masked by those at the wetter stations. Since the annual rainfall at different places in Norway varies from 250 to 3,000 mm., the ordinary methods of calculating regional rainfall distribution give undue weight to the wetter regions. Birkeland's method gives equal value to all stations according to the percentage variation; it should also be noticed that at any one station a deviation from the monthly normal of, say, 10 mm., in whatever month it occurs, always has the same value.

At Bergen, which has a rainfall record commencing in 1851, the 56 years ending in 1916 were formed into 17 consecutive 40-year annual means, and it was found that the mean departure from the 56-year normal was only 1·00 per cent. The probable error of the 40-year mean at all stations was calculated at 2·0 per cent. The probability of the occurrence of high and low percentage values in each month is also considered.

H. Mohn. Atlas de Climat de Norvège. Nouvelle édition par Aage Graarud et Kristen Irgens. Geofysiske Publ., Vol. II., No. 7. Kristiania, 1921. Size 12 by 9, pp. 5, plates 60.

THIS useful work is a new edition of the *Atlas of Norwegian Climate* compiled by H. Mohn, mainly on the basis of his well-known *Klima-Tabeller for Norge*. The present atlas is based on the values for the 40 years 1874 to 1913, incomplete records being reduced by comparison. The former year is that in which observations in Norway were first organised in international form, as a result of the first Congress at Vienna in 1873.

The charts are clearly reproduced in black and white on the scale of 1 : 7,500,000, which gives one map to a page. They include mean monthly temperature, reduced to sea level, annual range, warmest and coldest days and extreme temperatures. The method of calculating the warmest and coldest days is interesting. The temperatures of the middle day of each month were plotted, and through the three highest a parabola was drawn with its axis parallel to the temperature ordinate; the highest point gave the warmest day. The coldest day was found in a similar way. The extremes were taken directly from the records; presumably no correction was applied for height or length of record; in such a mountainous country neglect of the former correction must somewhat reduce the value of the data. The effect of the warm coastal waters is well shown in several of these charts. Days of mean temperature below 0° C. and days of

frost complete the temperature charts. Then follow maps of vapour tension and relative humidity (for four months only), pressure and wind by months, and wind force, days of gale, cloudiness, fogs and thunderstorms by seasons. The maps of fog distribution rather strongly suggest the presence of the personal equation, but even so they are of great interest, especially as showing the oscillation of the area of greatest fog from the south in winter to the north in summer. A rather surprising point is the omission of annual charts (except for the days below 0° C. and days of frost); we are not told whether this was due to the additional labour or expense involved or whether, in common with some other meteorologists, the authors regard annual charts as of little value.

There are no rainfall charts in this volume, such having already been published in great detail in connection with the series *Nedboriagttelser i Norge*, the last edition being in 1921. The combination of these two sets gives a very valuable graphic presentation of the climate of Norway, which will be welcomed by all meteorologists.

News in Brief.

THE Meteorological Office was drawn against the Finance Department in the first round of the Inter-departmental Cricket Competition of the Air Ministry.

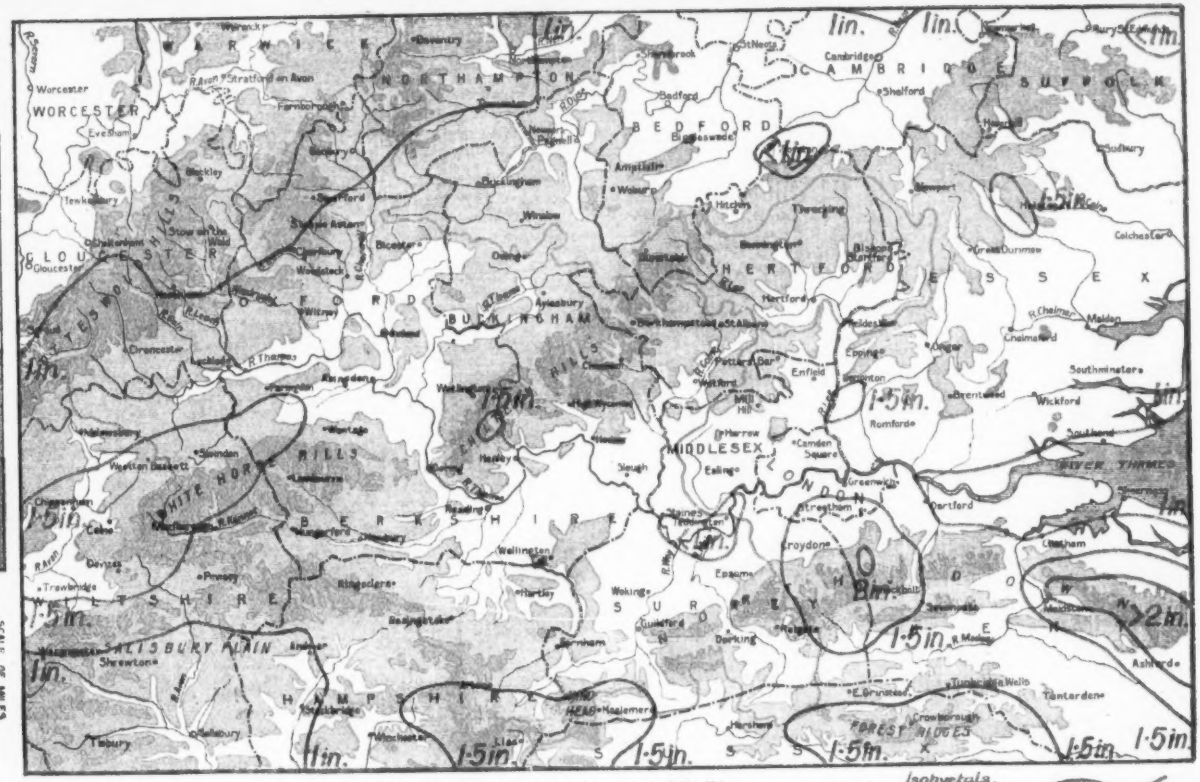
The match was played at Eltham on Friday, June 23rd, the Meteorological Office team being captained by Mr. C. W. Lamb. The game resulted in a win for the Office after a very exciting struggle, the scores being 72 and 62. The honours went to Mr. E. G. Ward, who scored 28 and was responsible for 6 wickets at a small cost.

The team was encouraged in its efforts by the presence of the Director and several other memers of the Staff.

A Climatological station of the Health Resort type has been established at North Berwick under municipal auspices. The site is at the hospital on the outskirts of the town. Since July 5th the afternoon observations have been included in the schedule issued to the newspapers by the Meteorological Office, London.

The Climatological station at Ridgewell is being closed at the end of July, and Mr. F. J. Gurney is anxious to dispose of the meteorological instruments there. Readers wishing for particulars should communicate with him at Ridgewell Hill, Halstead, Essex.

THAMES VALLEY RAINFALL —— JUNE, 1922.



S.M. Stationery Office Press, Kingsway, W.C.2

PHOTOZINCOGRAPH BY H.M. STATIONERY OFFICE

Snow on the Pordio and Falzarego Passes in the Italian Tyrol melted sufficiently for the first public motor-coach service of the season to be run on May 30th over the entire length of the Dolomite Road.

Four fine water spouts swiftly approached Biarritz from the sea on the early morning of June 21st. They dispersed on reaching the sands.

The Weather of June, 1922.

THE weather of the first week of June was dry and hot, generally continuing the drought of the previous month, so that in many places there was anxiety with regard to water supplies and to the condition of crops. In the second half of the month a series of depressions, approaching Europe from the Atlantic, gave unsettled, cool weather with considerable rainfall and strong winds.

On the 1st a deep depression over Finland and a High to the north of Scotland caused northerly gales over Scandinavia, Denmark and northern Germany, while the British Isles and France were in a "flat" area. Fine, hot weather was enjoyed in the latter districts with day temperatures reaching 85° F. in most places. On the 2nd a shallow depression approaching the Hebrides caused an increase of wind in the west, with a lowering of temperature and thunderstorms at some places in the British Isles, France and Switzerland. This shallow depression deepened considerably as it moved N.E. on the 2nd; it then remained almost stationary off the east coast of Iceland until the 5th, during which time it gradually filled up. Further south the Azores anticyclone extended slowly in a north-easterly direction, bringing finer and warmer weather to England, France and the Netherlands, although heavy rain was associated with a shallow V-shaped depression moving across Denmark and northern Germany on the 4th. Thunderstorms at Geneva and Guernsey on the 6th gave heavy rain locally. On the 8th a shallow depression developed over France. This depression moved north, giving a definite, if weak, cyclonic circulation over England on the 9th. No rain showers were associated with this depression except in Wales and south-west England.*

Heavy rain associated with an irregular system of Lows over Central Europe fell in France, Switzerland and Denmark on the 10th and 11th, while the weather of Great Britain, improving on the 10th became fair on the 11th and 12th as the anticyclone north-east of the Azores extended

(*Continued on p. 175.*)

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* The track of a sample of air crossing the Norfolk coast on the morning of the 8th showed a slow movement to Wales and then an abrupt turn eastwards, the air then passing near Ross and Benson and finally across London on the afternoon of the 10th. It was always dry, and the temperature of the upper air over Helder on the 8th was well above the normal. Over England the upper winds were generally easterly up to at least 6,000 feet on the 8th, and were south-westerly in the south but still easterly in the north on the 9th. Mr. E. V. Newnham, to whom this observation is due, remarks: "It seems safe to conclude that dryness of the air combined with high temperatures up above prevented the formation of any considerable rain area."

Rainfall Table for June 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·02	1·12	28	55	·42	28	9
Tenterden (View Tower)	*Kent*	1·91	1·21	31	63	·26	14	12
Arundel (Patching Farm)	*Sussex*	2·02	1·79	45	89	·43	26	12
Fordingbridge (Oaklands)	*Hampshire*	1·85	·87	22	47	·20	13	11
Oxford (Magdalen College)	*Oxfordshire*	2·13	1·30	33	61	·47	13	8
Wellingborough (Swanspool)	*Northampton*	2·10	1·20	31	57	·29	13	11
Hawkedon Rectory	*Suffolk*	2·07	1·14	29	55	·39	28	11
Norwich (Eaton)	*Norfolk*	1·93	1·67	42	87	·57	13	13
Launceston (Polapit Tamar)	*Devon*	2·15	1·15	29	53	·32	25	11
Sidmouth (Sidmount)	„	2·10	·67	17	32	·22	25	9
Ross (County Observatory)	*Herefordshire*	2·15	·58	15	27	·17	13	8
Church Stretton (Wolstaston)	*Shropshire*	2·42	1·12	28	46	·21	24	11
Boston (Black Sluice)	*Lincoln*	1·82	1·16	29	64	·35	13	9
Worksop (Hodsock Priory)	*Nottingham*	1·98	·86	22	43	·39	13	9
Mickleover (Clyd House)	*Derbyshire*	2·39	·91	23	38	·25	29	11
Southport (Hesketh Park)	*Lancashire*	2·17	2·14	54	99	·50	27	14
Wetherby (Ribston Hall)	*York, W. R.*	2·10	2·09	53	100	·56	24	7
Hull (Pearson Park)	„ *E. R.*	2·06	1·04	..	50	·27	13	11
Newcastle (Town Moor)	*North'land*	2·17	1·75	44	81	·36	23	13
Borrowdale (Seathwaite)	*Cumberland*	6·52	8·10*	206	124	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	2·49	1·21	31	49	·31	25	13
Haverfordwest (Gram. Sch.)	*Pembroke*	2·70	2·30	58	85	·65	9	10
Aberystwyth (Gogerddan)	*Cardigan*	3·11	2·01	51	65	·45	12	9
Llandudno	*Carnarvon*	2·03	1·45	37	71	·33	12	13
Dumfries (Cargen)	*Kirkcudbrt.*	2·78	2·04	52	73	·41	22	16
Marchmont House	*Berwick*	2·31	1·57	40	68	·65	12	11
Girvan (Pinmore)	*Ayr*	2·89	4·00	102	139	1·02	18	21
Glasgow (Queen's Park)	*Renfrew*	2·31	1·57	40	68	·25	12	14
Islay (Eallabus)	*Argyll*	2·62	3·52	89	134	·45	21	21
Mull (Quinish)	„	2·97	3·87	98	130	·64	12	22
Loch Dhu	*Perth*	4·17	3·10	79	74	·55	22	17
Dundee (Eastern Necropolis)	*Forfar*	1·80	1·84	47	102	·41	22	16
Braemar (Bank)	*Aberdeen*	1·96	1·30	33	66	·24	23	12
Aberdeen (Cranford)	„	1·80	2·39	61	133	·57	12	16
Gordon Castle	*Moray*	2·04	1·60	41	78	·49	12	17
Fort William (Atholl Bank)	*Inverness*	3·58	4·00	102	112	·53	9	24
Alness (Ardross Castle)	*Ross*	2·26	1·04	26	46	·17	9	18
Loch Torridon (Bendamph)	„	4·08	5·55	141	136	·56	28	24
Stornoway	„	2·32	2·73	69	118	·31	19	24
Loch More (Achfary)	*Sutherland*	3·70	5·69	145	154	·65	18	27
Wick	*Caithness*	1·80	1·81	46	101	·26	25	23
Glanmire (Lota Lodge)	*Cork*	2·70	1·33	34	49	·33	30	12
Killarney (District Asylum)	*Kerry*	2·91	2·09	53	72	·34	9	21
Waterford (Brook Lodge)	*Waterford*	2·69	1·17	30	44	·40	30	12
Nenagh (Castle Lough)	*Tipperary*	2·45	..	..	..	..	..	..
Foynes	*Limerick*	2·58	..	..	..	..	..	..
Gorey (Courtown House)	*Wexford*	2·43	1·13	29	47	·41	30	8
Abbey Leix (Blandsfort)	*Queen's Co.*	2·59	1·77	45	68	·31	29	16
Dublin (Fitz William Square)	*Dublin*	1·95	·78	20	40	·16	12	12
Mullingar (Belvedere)	*Westmeath*	2·60	1·36	35	52	·22	25	14
Crossmolina (Enniscoe)	*Mayo*	3·00	..	..	..	..	..	..
Collooney (Markree Obsy.)	*Sligo*	3·01	3·03	77	101	·55	24	21
Seaforde	*Down*	2·76	2·18	55	79	·35	27	13
Ballymena (Harryville)	*Antrim*	2·91	2·44	62	84	·43	22	19
Omagh (Edenfel)	*Tyrone*	2·82	3·27	83	116	·50	22	20
Letterkenny Asylum	*Donegal*	2·90	2·23	57	77	·30	24	19

* Read on 2nd July.

Supplementary Rainfall, June 1922.

Div.	STATION.	RAIN.		Div.	STATION.	RAIN.	
		in.	mm.			in.	mm.
II.	Ramsgate	1·75	44	XII.	Langholm, Drove Rd.	2·64	67
,,	Sevenoaks, Speldhurst	1·54	39	XIII.	Ettrick Manse	1·80	46
,,	Hailsham Vicarage	1·51	38	,,	North Berwick Res.	1·88	48
,,	Totland Bay, Aston Ho.	1·08	27	,,	Edinburgh, Royal Ob.	1·69	43
,,	Ashley, Old Manor Ho.	1·79	45	XIV.	Biggar	1·75	44
,,	Grayshott	2·02	51	,,	Leadhills	5·13	130
,,	Ufton Nervet	1·25	32	,,	Kilmarnock, Agric. Coll.	3·02	77
III.	Harrow Weald, Hill Ho.	1·30	33	XV.	Dougarie Lodge	4·05	103
,,	Pitsford, Sedgebrook	·90	23	,,	Oban	4·16	106
,,	Chatteris, The Priory	·84	21	,,	Holy Loch, Ardnadam	4·01	102
IV.	Elsenham, Gaunts End	1·09	28	,,	Tiree, Cornaigmore	..	..
,,	Lexden, Hill House	1·08	27	XVI.	Loch Venachar	2·30	58
,,	Aylsham, Rippon Hall	1·65	42	,,	Glenquey Reservoir	2·10	53
,,	Swaffham	1·18	30	,,	Loch Rannoch, Dall	2·04	52
V.	Devizes, Highclere	1·56	40	,,	Blair Atholl	1·26	32
,,	Weymouth	·71	18	,,	Coupar Angus	1·58	40
,,	Ashburton, Druid Ho.	·97	25	,,	Montrose Asylum	1·21	31
,,	Cullompton	1·03	26	XVII.	Logie Coldstone, School	1·60	41
,,	Hartland Abbey	1·43	36	,,	Fyvie Castle	2·01	51
,,	Penzance, Morrab Gden.	1·09	28	,,	Grantown-on-Spey	1·42	36
,,	St. Austell, Trevarna.	1·37	35	XVIII.	Kingussie, Fasnakyle	1·95	49
,,	Crewkerne Merefield Ho	·69	17	,,	Fort Augustus	1·76	45
VI.	Clifton College	1·54	39	,,	Loch Quoich, Loan	9·70	246
,,	Ledbury, Underdown.	·74	19	,,	Fortrose	·64	16
,,	Shifnal, Hatton Grange	·56	14	,,	Faire-na-Squir	4·43	113
,,	Ashbourne, Mayfield.	1·15	29	,,	Skye, Dunvegan	4·04	103
,,	Barnt Green, Upwood	·86	22	XIX.	Loch Carron, Plockton.	3·46	88
,,	Blockley, Upton Wold	·83	21	,,	Dornoch, St. Gilbert's	1·14	29
VII.	Leicester, Town Hall Sq.	·52	13	,,	Tongue Manse	3·50	89
,,	Grantham, Saltersford	1·04	26	,,	Melvich Schoolhouse	2·30	58
,,	Louth, Westgate	1·32	33	XX.	Dunmanway Rectory	1·54	39
,,	Mansfield, West Bank	1·37	35	,,	Mitchelstown Castle	..	..
VIII.	Nantwich, Dorfold Hall	1·43	36	,,	Gearahameen	1·80	46
,,	Bolton, Queen's Park.	3·10	79	,,	Darrynane Abbey	1·41	36
,,	Lancaster, Strathspey.	3·04	77	,,	Cashel, Ballinamona	1·44	37
IX.	Wath-upon-Dearne	·71	18	,,	Roscrea, Timoney Park	..	..
,,	Bradford, Lister Park.	1·41	36	,,	Ballybunion	..	..
,,	West Witton	1·56	40	,,	Broadford, Hurdlestown	2·59	66
,,	Scarborough, Scalby	1·97	50	XXI.	Kilkenny Castle	1·42	36
,,	Middlesbro', Albert Pk.	1·65	42	,,	Rathnew, Clonmannon	1·11	28
,,	Mickleton	1·20	31	,,	Hacketstown Rectory	..	..
X.	Bellingham	1·59	40	,,	Balbriggan, Ardgillan	1·20	31
,,	Ilderton, Lilburn	1·43	36	,,	Drogheda	1·13	29
,,	Orton	2·44	62	,,	Athlone, Twyford	1·22	31
XI.	Llanfrechfa Grange	..	..	XXII.	Castle Forbes Gdns.	1·46	37
,,	Treherbert, Tyn-y-waun	2·58	65	,,	Ballynahinch Castle	3·82	97
,,	Carmarthen Friary	1·96	50	,,	Galway, Grammar Sch.	1·59	40
,,	Lampeter, Falcondale	1·87	47	XXIII.	Westport House	..	..
,,	Cray Station	1·80	46	,,	Enniskillen, Portora	2·30	58
,,	B'ham W.W., Tyrmyndd	1·87	47	,,	Armagh Observatory	2·15	55
,,	Lake Vyrnwy	3·15	80	,,	Warrenpoint	1·57	40
,,	Llangynhafal, P. Drâw	1·75	44	,,	Belfast, Cave Hill Rd.	2·54	65
,,	Oakley Quarries	4·21	107	,,	Glenarm Castle	1·93	49
,,	Dolgelly, Bryntirion	2·88	73	,,	Londonderry, Creggan.	3·36	85
,,	Snowdon, L. Llydaw.	7·77	197	,,	Sion Mills	2·21	56
,,	Lligwy	1·72	44	,,	Milford, The Manse	2·63	67
XII.	Stoneykirk, Ardwell Ho.	..	..	,,	Narin, Kiltoorish	3·43	87
,,	Carsphairn, Shiel	3·26	83	,,	Killybegs, Rockmount	4·43	113

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	°F.		°F.		°F.	°F.	°F.	°F.
London, Kew Observatory	1009·8	−7·5	57	2	26	18	45·3	35·4	40·4	+1·5
Gibraltar	1020·1	+0·6	68	29	42	67	61·6	50·0	55·8	+0·2
Malta	1012·8	−3·4	65	31	41	6	57·5	50·7	54·1	−0·5
Sierra Leone	1010·9	−0·3	93	18	68	2	89·3	73·9	81·6	+0·1
Lagos, Nigeria	1013·3	+3·4	90	18	69	12	87·0	74·9	80·9	−0·1
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1006·7	−1·2	91	18, 20, 31	60	4	83·0	64·3	73·7	+1·3
Salisbury, Rhodesia	1004·8	−4·5	96	19	42	4	89·9	53·4	71·7	+2·2
Cape Town	1012·7	−0·7	92	4	49	17	78·9	58·3	68·6	−1·2
Johannesburg	1010·0	+0·3	85	18	49	1	79·7	57·4	68·5	+2·3
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	95	20	53	31	88·4	60·7	74·5	+1·3
Calcutta, Alipore Obsy.	1014·9	−0·3	84	1	51	6	78·6	56·5	67·5	+1·1
Bombay	1012·5	−0·7	89	4	60	3	83·7	68·2	75·9	+0·7
Madras	1015·3	+1·4	87	30	64	30	83·5	68·4	75·9	−0·2
Colombo, Ceylon	1010·8	0·0	93	26	67	24	88·3	71·7	80·0	+0·2
Hong Kong	1018·8	−0·6	74	9	48	19	64·5	57·6	61·1	+0·8
Sandakan	..	..	88	17, 24, 25	73	8, 22, 31	85·2	74·7	79·9	0·0
Sydney	1007·7	−4·8	97	5	56	26	78·7	63·3	71·0	−0·6
Melbourne	1008·8	−4·1	101	22	48	17	78·3	56·9	67·6	+0·1
Adelaide	1009·6	−3·4	103	18	50	14	80·5	59·6	70·1	−4·0
Perth, Western Australia	1012·0	−0·5	99	14	55	6	82·3	61·6	71·9	−1·9
Coolgardie	1009·2	−2·2	109	16	48	6	93·6	62·0	77·8	+0·4
Brisbane	1006·9	−4·4	99	29	61	2	87·8	69·7	78·7	+1·5
Hobart, Tasmania	1008·5	−1·8	94	18	45	30	70·0	53·7	61·9	−0·4
Wellington, N.Z.	1015·6	+2·8	75	31	47	30	68·2	55·0	61·6	−1·1
Suva, Fiji	1006·2	−1·5	91	26, 31	68	8	86·7	72·1	79·4	−0·5
Kingston, Jamaica	1014·6	−0·7	89	30	65	3	86·0	68·1	77·1	+0·3
Grenada, W.I.	1013·0	+0·2	86	4, 8, 9	70	8, 9, 15	82·6	72·9	77·7	+0·7
Toronto	1021·9	+4·5	46	5	− 1	2	30·1	16·4	23·3	+1·2
Winnipeg	1020·0	+0·2	35	28	−38	22	12·0	−6·0	3·0	+7·4
St. John, N.B.	1017·4	+1·7	44	12	−13	24	26·9	8·2	17·5	−1·7
Victoria, B.C.	1021·1	+5·8	47	10	21	30	39·9	32·7	36·3	−3·8

LONDON, KEW OBSERVATORY.—Prevailing wind direction westerly, mean speed 9·4 mi/hr. 4 days with snow.

GIBRALTAR.—Prevailing wind direction W. 5 days with gale.

MALTA.—Prevailing wind direction westerly. 8 days with hail, 3 days with thunder heard, 2 days with gale.

SIERRA LEONE.—Calms predominate over S.W. 12 days with harmattan.

SALISBURY, RHODESIA.—Prevailing wind direction SE.

COLOMBO, CEYLON.—Prevailing wind direction N., tendency to NW. in late afternoon, mean speed 6·0 mi/hr. 2 days with thunder heard.

ADELAIDE:—										
Dec. 1921 - -	1013·7	+0·5	97	19	51	15	81·3	58·8	70·1	−1·1
Year 1921 - -	1017·4	+0·3	110	Jan. 23	37	June 27 Aug. 6	74·5	54·8	64·7	+1·7

British Empire, January 1922.

TEMPERATURE				PRECIPITATION				BRIGHT SUNSHINE		STATIONS
Mean	Absolute	Relative Humidity	Mean Cloud Am'nt	Amount		Diff. from Normal	Days	Hours per day	Percentage of possible	
Wet Bulb.	Min. on Grass									
° F.	° F.	%	0–10	in.	mm.	mm.				
30·2	32	84	7·5	2·23	57	+ 12	20	1·6	18	London, Kew Observatory.
52·0	33	79	4·2	2·35	60	− 70	9	..	..	Gibraltar.
50·1	35	81	6·7	3·64	92	+ 17	20	3·8	38	Malta.
74·1	..	66	1·9	0·00	0	− 11	0	..	..	Sierra Leone.
74·7	68	88	9·3	0·59	15	− 13	2	..	..	Lagos, Nigeria.
..	..	..	..	..	..	..	..	..	..	Kaduna, Nigeria.
..	..	78	3·9	0·93	24	−261	6	..	..	Zomba, Nyasaland.
64·4	..	50	..	0·79	20	−181	2	..	..	Salisbury, Rhodesia.
62·8	..	59	3·5	1·66	42	+ 25	8	..	..	Cape Town.
58·8	47	65	4·2	2·58	66	− 93	18	9·0	66	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
62·0	..	54	2·7	1·85	47	− 55	8	..	..	Bloemfontein.
57·7	42	37	2·2	0·00	0	− 10	0*	..	..	Calcutta, Alipore Obsy.
68·0	50	64	0·9	0·00	0	− 2	0*	..	..	Bombay.
70·7	60	76	3·9	3·42	87	+ 64	7*	..	..	Madras.
74·4	58	64	4·4	2·12	54	− 37	9	..	..	Colombo, Ceylon.
57·2	..	81	8·3	2·66	68	+ 31	15	3·1	28	Hong Kong.
77·1	..	89	..	19·43	494	+ 25	19	..	..	Sandakan.
65·8	50	65	5·1	7·01	178	+ 87	20	7·5	53	Sydney.
59·5	40	53	5·2	1·18	30	− 17	10	..	..	Melbourne.
58·4	40	44	4·5	2·22	56	+ 38	8	9·3	66	Adelaide.
63·3	48	54	3·2	0·10	3	− 6	3	10·3	74	Perth, Western Australia.
63·0	..	30	2·5	0·00	0	− 12	0	..	..	Coolgardie.
71·4	56	61	4·7	3·62	92	− 71	11	..	..	Brisbane.
55·6	40	64	7·0	2·61	66	+ 21	23	6·1	41	Hobart, Tasmania.
57·1	33	75	7·0	0·68	17	− 69	12	5·6	38	Wellington, N.Z.
77·2	..	80	5·7	25·15	639	+367	16	..	..	Suva, Fiji.
..	..	71	4·5	0·35	9	− 15	3	..	..	Kingston, Jamaica.
72·5	..	75	3·9	6·24	158	+ 45	22	..	..	Grenada, W.I.
19·3	−4	51	5·9	1·38	35	− 38	11	..	..	Toronto.
0·8	..	..	4·0	0·27	7	− 12	4	..	..	Winnipeg.
14·8	−14	58	4·1	3·36	85	− 37	8	..	..	St. John, N.B.
34·2	16	88	6·3	2·77	70	− 45	19	..	..	Victoria, B.C.

* For Indian stations a day of rain is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

HONG KONG.—Prevailing wind direction E, mean speed 13·4 mi/hr.

ADELAIDE.—Only 2 cooler Januaries in the past 65 years.

PERTH.—Prevailing wind direction S., mean speed 13·8 mi/hr.

WELLINGTON.—Prevailing wind, direction S.

SUVA, FIJI.—Prevailing wind direction variable. 6 days with thunder heard.

GRENADA, W.I.—Prevailing wind direction NE.

										ADELAIDE:—
59·5	40	48	4·0	0·50	13	− 11	6	9·6	67	Dec. 1921.
55·9	27	55	4·5	22·65	575	+ 43	100	7·3	60	Year 1921.

Reference Table.—Climatological Table for the British Empire.

STATIONS.	Lat.	Long.	Height above M.S.L.	Hours of Observation.*	AUTHORITY.	Period of Normals. Pressure.	Temp.	Rainfall.
			Ft.					
London, Kew Obsy	51°28′N	0°19′W	34	9, 15, 21	Meteorological Office, Air Ministry, London.	'71-'15	'81-'15	'81-'15
Gibraltar - -	36° 6′N	5°21′W	53	†7,13,21	Colonial Secretary, Gibltr.	'91-'15	'76-'19	'52-'19
Malta - - -	35°53′N	14°28′E	185	†7, 18	Meteorological Office, Air Ministry, London.	'83-'19	{'53-'65 '04-'19	'53-'19
Sierra Leone -	8°29′N	13° 9′W	224	9, 17	Principal Medical Officer	'91-'20	'75-'20	{'47-'51 '75-'20
Lagos, Nigeria -	6°22′N	3°28′E	13	9	Surveyor-General -	'91-'15	{'86-'00 '06-'15	'86-'19
Kaduna, Nigeria -	10°32′N	7°25′E	2,088	9	The Secretariat, Kaduna -	'91-'20	{'07, '09-'19	'04-'18
Zomba, Nyasaland	15°23′S	35°18′E	3,100	9, 21	Director of Agriculture -	'92-'16	'92-'16	'92-'16
Salisbury, Rhodesia	17°48′S	31° 5′E	55	8	Hydrographic Engineer -	{'98-'03 '07-'20	{'98-'03 '07-'20	'97-'20
Cape Town - -	33°56′S	18°29′E	40	8½,12·46	H.M. Astronomer - -	'41-'15	'42-'14	'41-'13
Johannesburg -	26°11′S	28° 4′E	5,925	8½	Chief Meteorologist, Pretoria	{9 yrs. '04-'13	'04-'19	'88-'13
Mauritius - -	20° 6′S	57°33′E	181	hourly	Royal Alfred Observatory	'61-'19	'61-'19	'61-'19
Bloemfontein -	29° 7′S	26°13′E	4,550	8½	Chief Meteorologist, Pretoria	'70-'84	{'81-'99 '03-'06	{'78-'99 '03-'13
Calcutta, Alipore Observatory.	22°36′N	88°23′E	21	10, 16	Director-General of Observatories, Simla.	'89-'10	'78-'10	'78-'10
Bombay - -	18°54′N	72°49′E	37	6,10,14, 16, 22	Do. do.	'89-'10	'78-'10	'78-'10
Madras - -	13° 4′N	80°14′E	22	10, 16	Do. do.	'89-'10	'78-'10	'78-'10
Colombo, Ceylon -	6°54′N	79°53′E	24	‡9½, 15½	Surveyor-General, Colombo	'52-'16	'52-'16	{63yrs. '52-'17
Hong Kong -	22°18′N	114°10′E	109	hourly	Director, Royal Obsy. -	'84-'13	'71-'10	'84-'13
Sandakan - -	5°49′N	118°12′E	—	9	Principal Medical Officer -	—	{'79-'95 '05-'20	{'79-'95 '05-'20
Sydney - -	33°51′S	151°13′E	133	9,15,21	Commonwealth' Meteorologist, Melbourne.	'59-'19	'59-'19	'59-'19
Melbourne - -	37°49′S	144°57′E	115	9,15,21	Do. do. - -	'58-'19	'56-'19	'56-'19
Adelaide - -	34°56′S	138°35′E	140	9,15,21	Do. do. - -	'57-'18	'57-'18	'39-'19
Perth, W. Australia	31°57′S	115°51′E	197	9,15,21	Do. do - -	'85-'19	'97-'19	'76-'19
Coolgardie - -	39°57′S	121°10′E	1,389	9, 15	Do. do. - -	'97-'19	'97-'19	'93-'19
Brisbane - -	27°28′S	153° 2′E	125	9,15,21	Do. do. - -	'87-'19	'87-'19	'52-'19
Hobart, Tasmania	42°53′S	147°22′E	177	9,15,21	Do. do. - -	'85-'19	'71-'19	{'41-'79 '82-'19
Wellington, N.Z. -	41°16′S	174°46′E	10	9	Meteorological Office, Wellington.	'65-'17	{'69-'87 '94-'17	'65-'17
Suva, Fiji - -	18° 8′S	178°26′E	20	9	Superintendent, Department of Agriculture.	'86-'16	'86-'18	'86-'18
Kingston, Jamaica	17°55′N	76°12′W	24	7, 15	Government Meteorologist	{'80-'99 '07-'18	{'80-'99 '07-'18	{'70, '72-'18
Grenada, W.I. -	12° 3′N	61°45′W	509	9, 18	Observer, Richmond Hill -	'76-'15	{'87, '91-'18	{'87, '91-'18
Toronto - -	43°40′N	79°24′W	379	8, 20	Director, Meteorological Service of Canada	'00-'18	78 yrs.	70 yrs.
Winnipeg - -	49°53′N	97° 7′W	760	7, 19	Do. do.	'00-'18	45 yrs.	'75-'14
St. John, N.B. -	45°17′N	66° 4′W	118	9, 21	Do. do.	'02-'18	45 yrs.	'61-'10
Victoria, B.C. -	48°24′N	123°19′W	230	5, 17	Do. do.	'00-'18	29 yrs.	'81-'10

* Local or zone time. † Mean max. temp. refers to period 7h. to 18h., mean min. temp. 18h to 7h.
‡ Cloud amount mean of 7h., 9½h., 15½h.

Changes in Climatological Table since January 1920—

Gibraltar. From Sept. 1921 the mean max. temp. referred to period 7h. to 18h., mean min. temp. 18h. to 7h.
Malta. From May 1921 the mean max. temp. referred to period 7h. to 18h., mean min. temp. 18h. to 7h., and the hours changed to 7h. and 15h., June 7h. and 16h., Oct. 7h. and 18h., July, height changed to 185ft.
Lagos. Hours changed in July 1921 to 9h.
Kaduna. Revised pressure normals adopted in January 1922.
Salisbury, Rhodesia. First included in May 1920.
Colombo, Ceylon. For mean wet bulb and humidity hours changed in July 1920 to 9½h. and 15½h.
Sandakan. First included in May 1921.
Wellington. In Sept. 1920, height changed to 9 feet.
Suva, Fiji. In March 1921, height changed to 20 feet.
Winnipeg. Replaced Fredericton, N.B. in July 1920.
Sierra Leone & Australian Stations. Revised normals adopted in January 1922.

(*Continued from p.* 169.)

in a north-easterly direction. By the morning of the 13th the High was established off the west coast of Ireland and a trough of low pressure extended over the North Sea and Central Europe, so that the whole of western Europe was flooded with air drawn from Polar regions. The maximum temperature at Kew Observatory fell from 76° F. on the 12th to 53° F. on the 14th. On the morning of the 14th, the High was situated over the North Sea and a shallow trough extended over Ireland. The weather was generally cool with occasional rain in most districts, sleet being reported from Dombaas in Norway. From the 16th to the 21st a High over the Azores and a succession of depressions passing east over Ireland gave a westerly type of cool, unsettled weather to north-west Europe, while in a "flat" area of low pressure in Central Europe heavy rain fell locally.

Heavy snowfalls occurred on the Bavarian mountains over the week-end June 17th-18th, and out of two climbing parties totalling seven persons, five lost their lives.

On the 21st the Azores High had moved further east and higher temperatures and fine weather were experienced in southern England and France, the temperature at Bordeaux reaching 90° F. A depression which appeared on the morning of the 22nd off the Hebrides moved slowly across Scotland and reached Denmark by the morning of the 26th; then it went slowly northwards, being centred in the north of Norway at the end of the month. This slow-moving depression brought considerable rainfall to the whole of north-west Europe, including northern France.

Extreme heat was being experienced in Geneva in the second week of the month and owing to the melting of the snow the lake overflowed its banks in many places. On the 20th it was reported that owing to the flooding of the principal pumping machinery there was a water shortage in the town.

R. A. W.

FOLLOWING a period of drought, violent storms occurred in south-eastern Europe. On the 20th a severe thunderstorm broke over Sofia, causing much damage. There was little or no loss of life, but ten thousand persons were estimated to be homeless. Three days later a violent storm with torrential rain destroyed the Transylvanian village of Bistritza and resulted in about twenty deaths.

On the 1st severe hailstorms which destroyed the crops in certain parts were reported from Algeria.

The amount and distribution of Indian rainfall during the month was satisfactory except in Katiawar, southern Hyderabad and southern Madras, where it was deficient. The monsoon was normal, and there were no storms in the Bay of Bengal.

A very severe gale occurred over northern New Zealand on the night of May 31st and continued until June 3rd. The s.s. *Wiltshire* was wrecked on Great Barrier Island, and the crew were rescued with great difficulty.

A message received on the 24th stated that south-west Japan was suffering from a drought such as had been unknown for forty years. Rice cultivation was being abandoned in many districts.

It was reported from Toronto on the 24th that a destructive wind storm had been experienced from eastern Saskatchewan to the Ontario boundary. Severe damage was done along the whole track of the storm and some lives were lost.

A report issued by the United States Weather Bureau on the 7th stated that temperatures in the cotton belt during the first week of the month were below normal. Rainfall was heavy in many localities, and the state of the crop was on the whole rather unfavourable. On Sunday, June 12th, the

region between Ohio and Massachusetts was visited by an extraordinarily violent storm. In New York the afternoon was brilliantly fine, and the storm came without warning. Although lasting barely half an hour damage and loss of life were caused to an extent without parallel in the history of the city. The storm appears to have been a complex system of tornadoes and waterspouts with violent thunder and lightning; the base of the clouds was estimated to be only a few hundred feet above the ground. The maximum wind speed was believed to be 100 miles per hour. Buildings were unroofed and large trees and sky signs blown about. The wind vortices sucked up all kinds of objects. At least 75 persons were killed and hundreds injured, City Island and the adjacent parts of Long Island Sound being the scene of the greatest number of casualties. The damage at Boston was estimated at a quarter of a million sterling, and many other towns were flooded. The important fruit crop of the Hudson and neighbouring valleys was entirely destroyed. On the same day the breaking of the river bank at San Salvador, in Central America, after several days of exceptional rain, destroyed part of the city. There were numerous casualties and two thousand persons were rendered homeless.

The chief feature of Argentine weather during the first half of the month was the prevalence of unsettled conditions. On the 15th a well-marked depression lay over the River Plate region accompanied by rain, with strong winds on the coast. Snow fell further west, and in the southern province of Chubut low temperatures were experienced, 9° F. being recorded at Sarmiento on the 13th. Fine, settled weather is usual in this month, and the mean pressure map shows a belt of high pressure from the South Pacific to the South Atlantic Oceans, crossing South America between 25° and 40° S. Lat.

The Portuguese naval airmen making their transatlantic flight arrived at Rio de Janeiro on the 17th, having flown a distance of 280 miles from Victoria. The weather was unfavourable with some rain and mist and poor visibility.

The special message from Brazil states that in the northern region the rainfall of the month was on the average 90 mm. above normal, several stations having over 200 mm. excess. Severe floods occurred in the Amazon Basin and in Parahyba State. Rainfall was also above average in the central and southern districts, and the cane and cotton crops have suffered generally. Temperature was on the whole in excess of normal. Violent storms occurred at the end of the month in the extreme south of the country.

The rainfall of the month of June was generally below the average, considerable areas in the southern half of Ireland and the centre of England receiving less than half the average. Areas with excess rainfall occurred mainly in the Western Highlands of Scotland. Less than 25 mm. (1 in.) for the month was recorded over a band from Sidmouth to Hull, including the greater part of the English Midlands, but hardly anywhere else. In the English Lake District and in Invernessshire falls of about 250 mm. (10 in.) were recorded very locally. In Ireland the fall was generally between 25 and 50 mm., exceeding that amount in the west and north.

The general rainfall expressed as a percentage of the average, was; England and Wales, 64; Scotland, 102; Ireland, 69; British Isles, 77.

In London, Camden Square, the mean temperature was 60·7° F., or 0·5° F. above the average; the duration of rainfall, 15·9 hours; and the evaporation, 3·36 inch.